A MODIFICATION OF THE REVOLVING MIRROR METHOD FOR MEASURING THE VELOCITY OF LIGHT

By A. A. Michelson

Ryerson Physical Laboratory, University of Chicago

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The accuracy of any measurement of the velocity of light by the revolving mirror depends on that of three factors:

(1) The distance between stations.

(2) The speed of rotation.

(3) The angle described by the revolving mirror while light goes to the distant station and returns.

It is estimated that (1) and (2) may be determined to within one part in 200,000 and possibly one in a million.

The third measurement may be eliminated by constructing a revolving mirror in the form of a prism with a square or octagonal base, the angles of which may be made equal to $90°$ (or $135°$) to this same order of accuracy.

For this a test angle is made by cementing a prism of approximately $90°$ (or of $45°$) to a true plane. The square (or octagon) is applied to the two surfaces, producing interference bands when illuminated by the light from a mercury lamp.

If these are straight and parallel to the axis of rotation, the angles are equal; if not the difference, α, is measured by $\epsilon/2b$, if ϵ is the fraction of the fringe width and b the width of the mirror face. Thus if $\epsilon = \lambda/20$ and $b = 15$ mm., $\alpha = 0.000001$, which will, therefore, be the order of accuracy of the measurement under these conditions. For a wider face the accuracy would be still greater. If the angle of the test prism is θ_0 and the measured differences are α_0, $\alpha_1 \ldots \alpha_n$, then completing the $360°$ gives $\theta_0 = (360 - \Sigma\alpha)/n$, whence $\theta_1 = \theta_0 + \alpha_1$, $\theta_2 = \theta_0 + \alpha_2$, etc.

The faces are corrected until the angles are all equal within the limit of error assigned. This method of constructing reflecting surfaces inclined at equal angles, which may readily be extended to any number of surfaces, may prove useful in the construction of standard test angles, which may thus be made accurate to a tenth of a second or less; and also in the subdivision of meridian circles, etc., in which the limit of error is of the order of one or two-tenths of a second.

Such a revolving mirror has been constructed in form of an octagon with faces of 15 by 20 mm. and with air under pressure of one atmosphere,

a speed of revolution of over 1000 turns per second has been attained. This makes it possible to obtain a rotation of 45° while light is passing twice over the distance between stations $12^1/_2$ miles apart; or of 90° if the stations are 25 miles apart.

It might be thought that with so small a mirror face the intensity of the return image would be insufficient; but by placing the revolving mirror in the focus of a very long focus lens or mirror, and placing the slit source at a distance $\nu = f^2/D$, in which f is the focal length and D the distance between stations, the intensity is a maximum and yet a small mirror is sufficient to return all the light which enters the lens. This last (or the concave mirror which replaces it) should be as large as possible as also, of course, the distant mirror.

Incidentally the eight reflections from the revolving mirror, will give four times as much light as a two-faced plane mirror.

Preparations are now in progress for a preliminary test of the method at Mt. Wilson, where it is hoped a distance of 25 miles may be utilized.

ON THE K SERIES OF X-RAYS

By WILLIAM DUANE AND WILHELM STENSTRÖM

JEFFERSON PHYSICAL LABORATORY, HARVARD UNIVERSITY

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In the research reported in this paper the authors have measured the wave-lengths of the emission lines and that of the critical absorption in the K series of tungsten. In order to obtain as precise values of the wave-lengths as possible they employed spectra of the first, second, third, fourth and, in one instance, the fifth order.

The object of the research has been to provide data for testing the following points: (a) The existence of a third line in the α-group; (b) the separation of the critical absorption from the line of shortest wave-length in the emission spectrum, namely the γ line; (c) the experimental and theoretical relations between the various lines in the K, L, M, etc., series; (d) the relative intensities of the emission lines; and (e) the equations for the wave-lengths that may be deduced from theories of the structure of atoms and the mechanism of radiation.

The X-ray spectrometer, the generating plant used to operate the X-ray tube, the instruments for controlling the current and voltage and the general method of making the measurements have been described in papers from this laboratory published during the last few years in the